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1071-8011-210

MONARCH INSTRUMENT

Instruction Manual

Monarch 120

True RMS Multimeter

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Safeguards and Precautions

1. **Read and follow all instructions in this manual carefully, and retain this manual for future reference.**
2. **Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.**
3. **Ensure that the instrument and test leads are in good condition with no visible signs of damage before use.**
4. **Ensure the test leads are installed in the proper connectors for the measurement to be made.**
5. **Ensure the Function Selector switch is in the proper position for the measurement to be made.**
6. **Do not, under any circumstances, exceed the maximum ratings of this instrument.**
7. **Do not exceed the rated voltage between any input jack and ground.**
8. **Do not measure resistance or continuity in a circuit or test diodes while power is applied to that circuit.**
9. **Discharge all capacitors in a circuit before measuring capacitance.**
10. **Do not connect the test leads to a voltage source when the test leads are connected to the µA /mA or 10A input jacks.**
11. **Exercise extreme caution when working with voltages above 60Vdc or 30Vac. Such voltages pose a shock hazard.**
12. **Keep fingers behind the finger guards on the test leads when making measurements.**
13. **To avoid false readings, replace the battery immediately when the low battery indication appears.**
14. **With the exception of replacing the battery or fuses, this instrument is not user serviceable. For technical assistance, contact the sales organization from which you purchased the product or Monarch Instrument directly.**

LIMITED WARRANTY

SELLER warrants hardware products to be free from any defect in materials or workmanship for a period of one (1) year from date of shipment to BUYER. SELLER's entire liability and BUYER's sole and exclusive remedy resulting from any defect in workmanship or material in the hardware product covered by this limited warranty shall be limited to and fully discharged by the SELLER's option of replacement or repair of such item without charge. The limited warranty provided in this clause is in lieu of all other warranties, expressed or implied, arising by law or otherwise. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXCLUDED. This limited warranty shall not be modified except by an arrangement signed by both parties specifically referencing this clause.

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This limited warranty does not extend or apply to consumables (including, but not limited to, lamps and batteries, if applicable) or equipment, instruments or accessories which are warranted separately by the original manufacturer of these items.

DECLARATION OF CONFORMITY

Monarch Instrument
Division of Monarch International Inc.
15 Columbia Drive, Amherst NH 03031 USA

declares that the product:

Name: **True RMS Multimeter**
Model: **Monarch 120**

to which this declaration relates is in conformity with the following standards:

EMC: **EN55022/1998, CISPR 22, Class B**
EN50082-1/1997 / EN61000-4 Series

and therefore conforms in accordance with 89/336/EEC-EMC Directive. The testing of this product was performed by GesTek EMC Lab. in July of 2000. (Ref. No. 0007018E).

19th July 2000
Importer (Amherst, NH)

Alan Woolfson, VP Engineering (Authorized Signature)

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1.0 Introduction:

This instrument is a true RMS autoranging digital multimeter capable of measuring AC voltage and current, DC voltage and current, resistance, continuity, frequency, RPM, temperature and capacitance. It is also equipped with a diode testing feature. The instrument complies with IEC 1010-1 1000V CAT III.

2.0 Specifications:

AC Voltage (Autoranging):

Range	Resolution	Accuracy		Input Impedance	Overload Protection
		45Hz~500Hz	500Hz~1KHz		
400mV	0.1mV			100M Ω	1200V peak
4V	1mV	0.5%+5	1%+5	10M Ω	1200V peak
40V	10mV	0.5%+5	1%+5	10M Ω	1200V peak
400V	100mV	0.5%+5	1%+5	10M Ω	1200V peak
750V	1V	0.8%+5	1.2%+5	10M Ω	1200V peak

AC Current (uA and mA - Autoranging):

Range	Resolution	Accuracy		Burden Voltage	Overload Protection
		45Hz~500Hz	500Hz~1KHz		
400uA	0.1uA	1.3%+5	1.6%+5	<0.25Vrms	0.5A / 600V Fast Blow Fuse
4000uA	1uA	1.3%+5	1.6%+5	<1Vrms	0.5A / 600V Fast Blow Fuse
40mA	10uA	1.3%+5	1.6%+5	<0.25Vrms	0.5A / 600V Fast Blow Fuse
400mA	100uA	1.3%+5	1.6%+5	<1.5Vrms	0.5A / 600V Fast Blow Fuse
20A	10mA	1.5%+5	1.8%+5	<1Vrms	15A / 600V Fast Blow Fuse

DC Voltage (Autoranging):

Range	Resolution	Accuracy	Input Impedance	Overload Protection
400mV	0.1mV	0.3%+2	100M Ω	1200Vpeak
4V	1mV	0.3%+2	10M Ω	1200Vpeak
40V	10mV	0.3%+2	10M Ω	1200Vpeak
400V	100mV	0.3%+2	10M Ω	1200Vpeak
1000V	1V	0.5%+2	10M Ω	1200Vpeak

DC Current (uA and mA - Autoranging):

Range	Resolution	Accuracy	Burden Voltage	Overload Protection
400uA	0.1uA	0.8%+2	<0.25V	0.5A / 600V Fast Blow Fuse
4000uA	1uA	0.8%+2	<1V	0.5A / 600V Fast Blow Fuse
40mA	10uA	0.8%+2	<0.25V	0.5A / 600V Fast Blow Fuse
400mA	100uA	0.8%+2	<1.5V	0.5A / 600V Fast Blow Fuse
20A	10mA	1%+2	<1V	15A / 600V Fast Blow Fuse

Resistance (Autoranging):

Range	Resolution	Accuracy	Test Voltage	Overload Protection
400 Ω	0.1 Ω	0.6%+2	<1.5VDC	600Vrms
4K Ω	1 Ω	0.6%+2	<1.5VDC	600Vrms
40K Ω	10 Ω	0.6%+2	<1.5VDC	600Vrms
400K Ω	100 Ω	0.6%+2	<1.5VDC	600Vrms
4M Ω	1K Ω	0.6%+2	<1.5VDC	600Vrms
40M Ω	10K Ω	1%+3	<1.5VDC	600Vrms

Continuity Beeper:

Range	Active Range	Test Voltage	Overload protection
•))	Under 40 Ω	<1.5V	600Vrms

NOTES

6.0 Battery and Fuse Replacement:

WARNING

To prevent electrical hazard or shock, turn multimeter off and disconnect test leads before removing back cover.

6.1 Opening the Instrument Case

When the low battery indicator shows in the display or when a fuse blows due to an overload condition, the case must be opened to replace the battery or fuse(s).

Set the Function Selector switch to the **OFF** position. Turn the unit over and remove the five screws from the back as shown in Figure 1.

Turn the unit face up and carefully separate the case halves as shown in Figure 2.

Figure 1

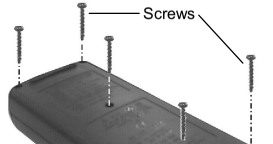
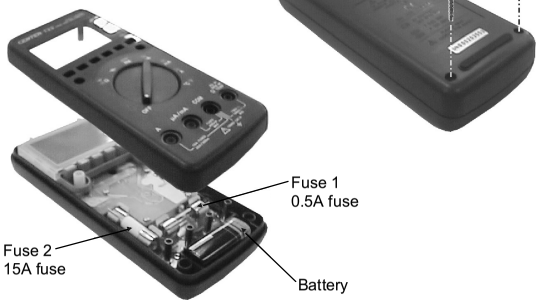


Figure 2



6.2 Battery Replacement

This instrument uses a single 9V, NEDA 1604 or IEC6F22 or JIS006P battery. When installing a new battery, be careful to route the battery leads through the slot in the battery enclosure. Failure to do so could result in damage to the leads upon replacement of the top half of the instrument case.

6.3 Fuse Replacement

WARNING

To avoid damage to the instrument or potential electrical hazard or shock, replace fuses with exact replacements. Do not use higher rated fuses in either location.

Remove and replace the defective fuse with an exact replacement.

Fuse ratings are as follows:

Fuse 1: F0.5A/600V 10 ∮ × 38mm Fast Blow

Fuse 2: F15A/600V 10 ∮ × 38mm Fast Blow

6.4 Closing the Instrument Case

Ensure the Function Selector switch has not been rotated from the position when it was removed. Check to be certain that the battery leads are safely routed through the slot provided for this purpose. Replace the top half of the instrument case, turn the instrument over, and replace the five screws in the back.

Note: Do not over tighten screws. Excessive tightening could strip the threads in the plastic case.

Diode Tester:

Range	Resolution	Accuracy	Test Current	Test Voltage	Overload protection
⊣◀	1mV	1% +2	<1mA	<3.5V	600Vrms

Frequency (Autoranging):

Range	Resolution	Accuracy	Sensitivity	Overload Protection
4KHz	1Hz	0.05%+1	<1Vrms	600Vrms
40KHz	10Hz	0.05%+1	<1Vrms	600Vrms
400KHz	100Hz	0.05%+1	<1Vrms	600Vrms
4MHz	1KHz	0.05%+1	<3Vrms	600Vrms
40MHZ	10KHz	0.05%+1	<10Vrms	600Vrms

RPM (Autoranging):

Range	Resolution	Accuracy	Sensitivity	Overload Protection
40K RPM	0.01K RPM	0.05%+1	<1Vrms	600Vrms
400K RPM	0.1K RPM	0.05%+1	<1Vrms	600Vrms
4M RPM	1K RPM	0.05%+1	<1Vrms	600Vrms
40M RPM	10K RPM	0.05%+1	<3Vrms	600Vrms
400M RPM	100K RPM	0.05%+1	<10Vrms	600Vrms

Temperature (°C/°F)

Range	Resolution	Accuracy		Overload protection
°C	1°	-50 to 0°C: 1%+4	0 to 1000°C: 1%+3	600Vrms
°F	1°	-58 to 32°F: 1%+8	32 to 1832°F: 1%+6	600Vrms

Capacitance (Autoranging)

Range	Resolution	Accuracy	Overload protection
4nF	1PF	1.9%+20	600Vrms
40nF	10PF	1.5%+10	600Vrms
400nF	100PF	1.5%+10	600Vrms
4uF	1nF	1.5%+10	600Vrms
40uF	10nF	1.9%+10	600Vrms
400uF	100nF	1.9%+10	600Vrms
4mF	1uF	1.9%+10	600Vrms
40mF	10uF	3%+10	600Vrms

Accuracy specification: ± ([…% of reading] + [… number of least significant digits]) at 18°C to 28°C (64°F to 82°F) at less than 80% RH
True RMS accuracy for ACV and ACA are specified from 5% to 100% of range. Add 1% of reading for crest factor between 1.4 and 3 at full scale, or less than 6 at half scale.

Electromagnetic compatibility:

Vac and Aac only: RF field = 3V/m

Total accuracy: Specified accuracy + 2% of range

Digital display: 4000 counts

Sampling rate: Twice per second

Analog display: 41 segments

Sampling rate: 20 times per second

Overrange indication: Displays 'OL' when value exceeds range selected

Digital Output: Bi-directional RS232. (Cable and software optional.)

Power requirement: 9 Volt battery, NEDA 1604 or JIS 006P or IEC 6F22

Battery life: 100 hours typical. Low battery indication.

Safety: 1000V CAT III, Regulation EN61010: Part 1:1993

Dimensions: Meter only: 198×86×38mm (7.8×3.4×1.5 in)
With holster: 209×94×48mm (8.2×3.7×1.9 in)

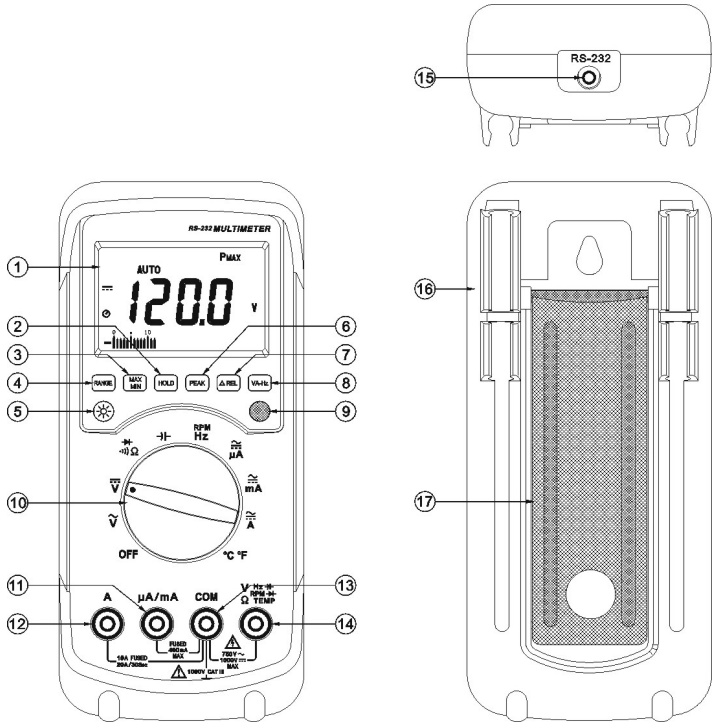
Weight: Meter only: Approx. 430g (15.2 oz)
With holster: Approx. 600g (21.3 oz)

Operating conditions:

- Operating Temperature and Humidity: 0°C - 40°C (32°F - 104°F)
  Below 80% RH Non-condensing
- Storage Temperature and Humidity: -10°C - 60°C (14°F - 140°F)
  Below 70% RH Non-condensing
- Installation category III
- Pollution Degree 2
- Indoor use only
- Altitude up to 2000 meters (6500 feet)

Accessories: Test Leads, Battery, Holster, Instruction Manual
Options: Temperature Converter, Type K Wire Temperature Probe, RS232 Cable, Software

3.0 Symbol Definitions and Button Locations:

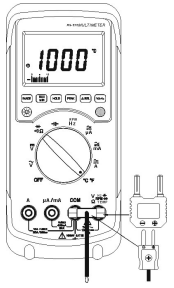


1) LCD Display
2) Hold Button
3) MAX/MIN Button
4) Range Button
5) Backlight Button
6) Peak Hold Button
7) Relative Button
8) Voltage/Current/Frequency Button
9) Second Function Button
10) Function Select Dial
11) 'µA/mA' Terminal
12) 'Amp' Terminal
13) 'COM' Terminal
14) 'Volts, Ohms, Frequency, RPM, Capacitance, Temperature, Diode Test Terminal'
15) RS232 Interface Connector
16) Holster
17) Tilt Stand

5.7 Frequency and RPM Measurements

1. Connect the red test lead to the '**Hz**' jack and the black test lead to the '**COM**' jack.
2. Set the Function Selector switch to the **Hz RPM** function. For RPM measurements, press the blue button to select the **RPM** function.
3. Connect the test leads in parallel with the circuit being measured.
4. Read the Frequency or RPM on the instrument display.

5.8 Temperature Measurements



1. Plug the optional temperature converter module into the '**TEMP**' and '**COM**' jacks, taking care to observe the proper polarities. Plug a Type K thermocouple into the converter, again ensuring proper polarity.
2. Set the Function Selector switch to the **°C °F** function.
3. Press the blue button, if necessary, to select °C or °F.
4. Locate the thermocouple probe in the environment to be measured and allow sufficient time for the probe temperature to stabilize.
5. Read the Temperature on the instrument display.

5.9 Capacitance Measurements

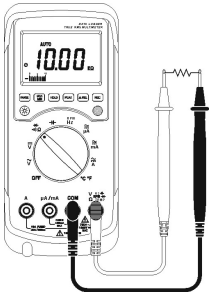
WARNING

To avoid damage to the instrument, disconnect circuit power and discharge all capacitors before measuring capacitance. Use the DC voltage function to confirm that all capacitors are fully discharged.

1. Connect the red test lead to the '⊣⊱' jack and the black test lead to the '**COM**' jack.
2. Set the Function Selector switch to the ⊣⊱ function.
3. Ensure there is no power applied to the circuit, and then connect the test leads to the leads of the capacitor being tested, observing proper polarity on polarized capacitors.
4. Read the Capacitance on the instrument display.

Notes:
1. The bar graph is disabled in the Capacitance measuring mode. However, in the 4mF and 40mF ranges, the bargraph indicates the time required to accomplish this measurement.
2. To obtain an accurate reading, the capacitor under test must be fully discharged. This instrument will automatically discharge the capacitor, if necessary, but requires considerable time to do so. Because of this time factor, it is preferable to discharge the capacitor by external means. If the instrument is discharging a capacitor prior to measurement, **disc** will appear on the display.

5.4 Resistance Measurements



WARNING

Before making any in-circuit measurements, remove power from the circuit being tested and discharge all capacitors in the circuit.

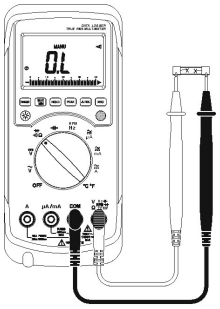
1. Connect the red test lead to the 'Ω' jack and the black test lead to the 'COM' jack.
2. Set the Function Selector switch to the Ω function.
3. Ensure there is no power applied to the circuit, and then connect the test leads in parallel with the circuit being tested and read the measured resistance on the instrument display.

5.5 Continuity Measurements

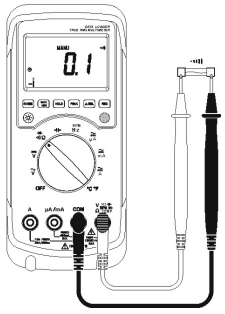
WARNING

Before making any in-circuit measurements, remove power from the circuit being tested and discharge all capacitors in the circuit.

1. Connect the red test lead to the 'Ω' jack and the black test lead to the 'COM' jack.
2. Set the Function Selector switch to the Ω •)) ⊣ function.
3. Press the blue Second Function button once to select the •)) function.
4. Ensure there is no power applied to the circuit, and then connect the test leads in parallel with the circuit being tested.
5. When the impedance between the test leads is less than 40Ω, a continuous beeper will activate.

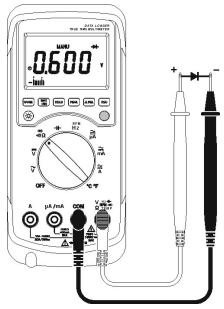


Open Circuit



Short Circuit

5.6 Diode Tests

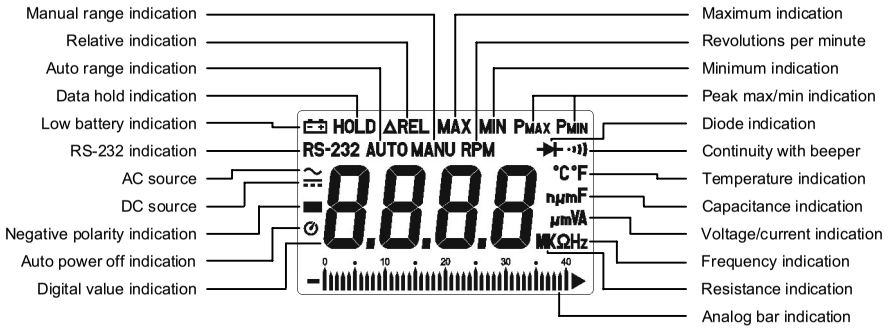


WARNING

Before making any in-circuit measurements, remove power from the circuit being tested and discharge all capacitors in the circuit.

1. Connect the red test lead to the ' ⊣ ' jack and the black test lead to the 'COM' jack.
2. Set the Function Selector switch to the Ω •)) ⊣ function.
3. Press the blue Second Function button twice to select the ⊣ function.
4. Ensure there is no power applied to the circuit, and then connect the red test lead to the anode side and the black test lead to the cathode side of the diode being tested.
5. Read the Forward Voltage (V_f) on the instrument display.

Note: If the polarity of the test leads is reversed, the display will read *'OL'*. This can be used to determine the anode and cathode terminals of a diode.



4.0 Control Functions:

4.1 Function Selector Rotary Switch

The rotary switch turns power on to the instrument and selects the function to be measured. The primary functions available are printed in red and white on the instrument scale. Alternate functions, accessed in conjunction with the blue Second Function Button, are printed in blue.

4.2 Range Button

The instrument powers on in the Auto Range mode, as indicated by the 'AUTO' indicator in the display. To select a Manual Range, press the RANGE button which will lock the meter in its' present range and bring on the 'MANU' indicator in the display. Each subsequent press of the RANGE button circulates the instrument to the next higher range or wraps from the highest back to the lowest range. To exit the Manual Range mode and return to Auto Range, press and hold the RANGE button for one second.

4.3 MAX/MIN Button

The Maximum and Minimum values are the highest and lowest values displayed during the time the instrument is in the MAX/MIN mode. To display Maximum and Minimum values, first ensure the value will not exceed the measurement range selected. Press the MAX/MIN button once to display the Maximum value, as indicated by the 'MAX' indicator in the display. Press it again to display the 'MIN' value and indicator. Press it once more to display the current value. In this selection, the 'MAX/MIN' indicator will flash. To exit the MAX/MIN mode, press and hold the MAX/MIN button for one second.

4.4 Data Hold Function

To hold the current measured value, press the HOLD button. Press the HOLD button again to release the held data and return to continuous reading.

4.5 Peak Hold Function

This instrument is equipped with a 1ms Peak capture capability in the ACA, ACV, DCA and DCV ranges. The Peak values are the highest and lowest transient values captured by the instrument, regardless of whether or not they might be displayed in the normal measuring mode. To display Peak values, first ensure the value will not exceed the measurement range selected. The instrument must then conduct an internal self-calibration, which calculates and stores the offset voltage in preparation for capturing a high speed Peak value.

To invoke the calibration operation, press and hold the PEAK button for approximately 2 seconds until 'CAL' appears in the display. The instrument is now calibrated to properly capture Peak values.

Press the PEAK button again to display the Maximum Peak, as indicated by the 'PMAX' indicator in the display. Press it once more to display the 'PMIN' value and indicator. Press and hold the PEAK button for 2 seconds to exit the Peak mode.

Note: The instrument must be calibrated in accordance with the above procedure whenever the function range is changed.

4.6 Relative Operation

Pressing the ΔREL button zeroes the display and internally stores the present reading as a reference for subsequent measurements. The display now shows the difference between the stored value and the new reading.

Press the ΔREL button again to hold the Relative reading. The 'ΔREL' symbol in the display will flash in the Relative Hold mode.

Press and hold the ΔREL for 1 second to exit the Relative mode.

4.7 Voltage or Current to Frequency Function

Press the VA-Hz button in any Voltage or Current measurement mode to enter the Frequency Counter mode with automatic range selection.

4.8 Backlight Button

The round yellow button with a 'Sun' logo turns the display backlight ON and OFF. The backlight automatically shuts off after 30 seconds to conserve battery power.

4.9 Second Function Button

The solid blue button selects the second functions printed in blue on the instrument scale around the rotary function selector.

The secondary functions available with this button are:

- In the Resistance position, the first press of the blue button selects the Continuity with beeper function. The second push of this button selects the Diode Test function.
- In the Frequency position, the blue button selects the RPM mode.
- In any of the Current measuring modes, the blue button toggles between AC and DC.
- In the Temperature function, the blue button toggles between °C and °F.

4.10 Auto Power Off

By default, the instrument powers on in the 'Auto Power Off' mode and will automatically shut off 30 minutes after the last key operation or optional RS232 communication.

To disable this feature, press and hold the RANGE button and then power on the meter. The ⏲ will not be displayed, indicating that 'Auto Power Off' is disabled.

4.11 20A Measuring Connector

This instrument is capable of measuring up to 10 amps continuously, or up to 20 amps for no more than 30 seconds. Connect the positive (red) test lead to this connector.

4.12 µA/mA Measuring Connector

Current measurements up to 400mA are best measured via this connector. This connection is internally fused at 400mA for protection of the instrument.

4.13 COM Measuring Connector

This connector is the negative (black) lead connection for all measurements.

4.14 V, Hz, ⊣(-, RPM, ▶|, Ω, TEMP Measuring Connector

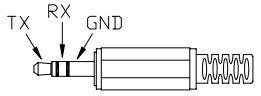
For all voltage, frequency, capacitance, RPM, diode test, resistance or temperature measurements, connect the positive (red) test lead to this connector.

4.15 Digital Output

The RS232 Digital Output is a 9600 bps N 81 serial interface.

RX is a 5V normally high input port.

TX is a 5V normally high output port.



5.0 Operating Instructions:

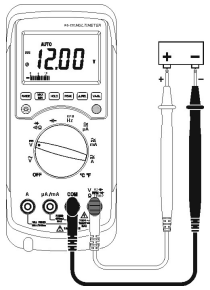
5.1 AC Voltage Measurements

WARNING

Maximum Input Voltage is 750VAC. To avoid electrical shock hazard and/or damage to this instrument, do not attempt to make any voltage measurement that may exceed this limit.

1. Connect the red test lead to the 'V' jack and the black test lead to the 'COM' jack.
2. Set the Function Selector switch to the **V~** range.
3. Connect the test leads in parallel with the circuit being measured.
4. Read the measured voltage on the instrument display.

5.2 DC Voltage Measurements



WARNING

Maximum Input Voltage is 1000VDC. To avoid electrical shock hazard and/or damage to this instrument, do not attempt to make any voltage measurement that may exceed this limit.

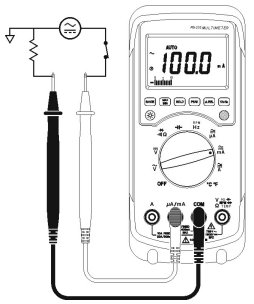
1. Connect the red test lead to the 'V' jack and the black test lead to the 'COM' jack.
2. Set the Function Selector switch to the **V ⎓** range.
3. Connect the test leads in parallel with the circuit being measured.
4. Read the measured voltage on the instrument display.

5.3 AC/DC Current Measurements

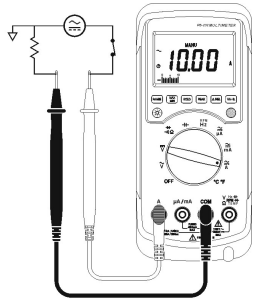
WARNING

To avoid injury, do not attempt a current measurement if the open circuit voltage exceeds the rated voltage of this instrument.

1. If the current to be measured is unknown, connect the red lead to the 'A' jack. If it is known or has been determined that the current is 400mA or less, connect the red lead to the 'µA/mA' jack. Connect the black lead to the 'COM' jack.
2. Set the Function Selector switch to the current range corresponding to the jack being used and press the blue button to select AC or DC.
3. Remove power from the circuit to be measured and connect the instrument in series with this circuit. Connect the black lead to the negative (-) side and the red lead to the positive (+) side being measured.
4. Apply power to the circuit and read the measured current on the instrument display.



µA/mA Measurement



Amp Measurement